

CLAIMS:

1. A method of establishing wireless communications between an interrogator and individual multiple wireless identification devices, the method comprising combining tree search and Aloha methods to establish communications between the interrogator and individual of multiple wireless identification devices.

2. A method in accordance with claim 1 wherein the combined Aloha methods are slotted Aloha methods.

3. A method in accordance with claim 1 wherein the wireless identification device comprises an integrated circuit including a receiver, a modulator, and a microprocessor in communication with the receiver and modulator.

1 4. A method of addressing messages from an interrogator
2 to a selected one or more of a number of communications devices,
3 the method comprising:

4 establishing a first predetermined number of bits to be used
5 as unique identification numbers, and establishing for respective
6 devices unique identification numbers respectively having the first
7 predetermined number of bits;

8 establishing a second predetermined number of bits to be used
9 for random values;

10 causing the devices to select random values, wherein
11 respective devices choose random values independently of random
12 values selected by the other devices;

13 transmitting a command from the interrogator requesting
14 devices having random values within a specified group of random
15 values to respond, the specified group being less than or equal to
16 the entire set of random values;

17 receiving the command at multiple devices, the devices
18 receiving the command respectively determining if the random value
19 chosen by the command falls within the specified group and, if so,
20 sending a reply to the interrogator within a randomly selected time
21 slot of a number of slots; and, if not, not sending a reply; and

22 determining with the interrogator if a collision occurred
23 between devices that sent a reply and, if so, creating a new,
24 smaller, specified group.

1 5. A method of addressing messages from an interrogator
2 to a selected one or more of a number of communications devices
3 in accordance with claim 4 wherein the sending of a reply to the
4 interrogator within a randomly selected time slot is in accordance
5 with an Aloha method.

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7 6. A method of addressing messages from an interrogator
8 to a selected one or more of a number of communications devices
9 in accordance with claim 4 wherein the sending of a reply to the
10 interrogator within a randomly selected time slot is in accordance
11 with a slotted Aloha method.

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13 7. A method of addressing messages from an interrogator
14 to a selected one or more of a number of communications devices
15 in accordance with claim 4 wherein the method is an adaptive
16 method.

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18 8. A method of addressing messages from an interrogator
19 to a selected one or more of a number of communications devices
20 in accordance with claim 4 wherein the number of slots is four.
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1 9. A method of addressing messages from an interrogator
2 to a selected one or more of a number of communications devices
3 in accordance with claim 4 wherein sending a reply to the
4 interrogator comprises transmitting the unique identification number
5 of the device sending the reply.
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7 10. A method of addressing messages from an interrogator
8 to a selected one or more of a number of communications devices
9 in accordance with claim 4 wherein sending a reply to the
10 interrogator comprises transmitting the random value of the device
11 sending the reply.
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13 11. A method of addressing messages from an interrogator
14 to a selected one or more of a number of communications devices
15 in accordance with claim 4 wherein, after receiving a reply without
16 collision from a device, the interrogator sends a command
17 individually addressed to that device.
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19 12. A method of addressing messages from an interrogator
20 to a selected one or more of a number of communications devices
21 in accordance with claim 4 wherein the time slot randomly selected
22 by a device is selected using a random number different from the
23 random value of that device.
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1 13. A method of addressing messages from an interrogator
2 to a selected one or more of a number of communications devices,
3 the method comprising:

4 establishing unique identification numbers for respective
5 devices;

6 causing the devices to select random values, wherein
7 respective devices choose random values independently of random
8 values selected by the other devices;

9 transmitting from the interrogator a command requesting
10 devices having random values within a specified group of random
11 values to respond, the specified group being less than or equal to
12 the entire set of random values;

13 receiving the command at multiple devices, the devices
14 receiving the command respectively determining if the random value
15 chosen by the device falls within the specified group and, if so,
16 sending a reply to the interrogator within a randomly selected time
17 slot of a number of slots; and, if not, not sending a reply; and

18 determining using the interrogator if a collision occurred
19 between devices that sent a reply and, if so, creating a new,
20 smaller, specified group.
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1 14. A method of addressing messages from an interrogator
2 to a selected one or more of a number of communications devices
3 in accordance with claim 13 wherein establishing unique
4 identification numbers for respective devices comprises establishing
5 a predetermined number of bits to be used for the unique
6 identification numbers.

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8 15. A method of addressing messages from an interrogator
9 to a selected one or more of a number of communications devices
10 in accordance with claim 14 and further including establishing a
11 predetermined number of bits to be used for the random values.

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13 16. A method of addressing messages from an interrogator
14 to a selected one or more of a number of communications devices
15 in accordance with claim 15 wherein the predetermined number of
16 bits to be used for the random values comprises sixteen bits.

1 17. A method of addressing messages from an interrogator
2 to a selected one or more of a number of RFID devices, the
3 method comprising:

4 establishing for respective devices unique identification
5 numbers respectively having a first predetermined number of bits;

6 establishing a second predetermined number of bits to be used
7 for random values;

8 causing the devices to select random values, wherein
9 respective devices choose random values independently of random
10 values selected by the other devices;

11 transmitting from the interrogator a command requesting
12 devices having random values within a specified group of random
13 values to respond, the specified group being less than or equal to
14 the entire set of random values;

15 receiving the command at multiple devices, the devices
16 receiving the command respectively determining if the random
17 values chosen by the device falls within the specified group and,
18 if so, sending a reply to the interrogator within a randomly
19 selected time slot of a number of possible time slots, in accordance
20 with an Aloha method; and, if not, not sending a reply, wherein
21 sending a reply to the interrogator comprises transmitting both the
22 random value of the device sending the reply and the unique
23 identification number of the device sending the reply, and wherein
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1 the time slot randomly selected by a device is selected using a
2 random number different from the random value of that device;

3 determining with the interrogator if a collision occurred
4 between devices that sent a reply and, if so, creating a new,
5 smaller, specified group; and

6 if a reply without collision is received from a device, the
7 interrogator subsequently sending a command individually addressed
8 to that device.

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10 18. A method of addressing messages from an interrogator
11 to a selected one or more of a number of RFID devices in
12 accordance with claim 17 wherein the number of possible time slots
13 is four.

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15 19. A method of addressing messages from an interrogator
16 to a selected one or more of a number of RFID devices in
17 accordance with claim 17 wherein the number of possible time slots
18 is four, wherein the first predetermined number of bits is sixteen,
19 and wherein the second predetermined number of bits is sixteen.

1 20. A method of addressing messages from an interrogator
2 to a selected one or more of a number of RFID devices in
3 accordance with claim 17 wherein the number of possible slots
4 varies from one specified group to another.

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6 21. A method of addressing messages from an interrogator
7 to a selected one or more of a number of RFID devices in
8 accordance with claim 17 and further comprising, after creating a
9 new, smaller, specified group:

10 the interrogator transmitting a command requesting devices
11 having random values within a specified group of random values to
12 respond, the specified group being less than or equal to the entire
13 set of random values; and

14 devices receiving the command respectively determining if
15 their chosen random values fall within the new smaller specified
16 group and, if so, sending a reply to the interrogator within a
17 randomly selected time slot of a number of possible time slots, in
18 accordance with an Aloha method.

22. A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim 21 and further comprising the subsequent steps of the interrogator determining if a collision occurred between devices that sent a reply and, if so, creating a new specified group and repeating the transmitting of the command requesting devices having random values within a specified group of random values to respond using different specified groups until all devices are identified, for every command the devices receiving the command determining if their chosen random values fall within the specified group and, if so, sending a reply to the interrogator within a randomly selected time slot of a number of possible time slots, in accordance with an Aloha method.

1 23. A communications system comprising an interrogator, and
2 a plurality of wireless identification devices configured to
3 communicate with the interrogator in a wireless fashion, the
4 respective wireless identification devices having a unique
5 identification number, the interrogator being configured to employ
6 tree search and Aloha techniques to determine the unique
7 identification numbers of the different wireless identification devices
8 so as to be able to establish communications between the
9 interrogator and individual ones of the multiple wireless
10 identification devices without collision by multiple wireless
11 identification devices attempting to respond to the interrogator at
12 the same time.

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14 24. A communications system in accordance with claim 23
15 wherein the Aloha technique is a slotted Aloha technique.

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17 25. A communications system in accordance with claim 23
18 wherein the wireless identification device comprises an integrated
19 circuit including a receiver, a modulator, and a microprocessor in
20 communication with the receiver and modulator.
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1 26. A system comprising:
2 an interrogator;
3 a number of communications devices capable of wireless
4 communications with the interrogator;
5 means for establishing a first predetermined number of bits
6 to be used as unique identification numbers, and for establishing
7 for respective devices unique identification numbers respectively
8 having the first predetermined number of bits;
9 means for establishing a second predetermined number of bits
10 to be used for random values;
11 means for causing the devices to select random values,
12 wherein respective devices choose random values independently of
13 random values selected by the other devices;
14 means for causing the interrogator to transmit a command
15 requesting devices having random values within a specified group
16 of random values to respond, the specified group being less than
17 or equal to the entire set of random values;
18 means for causing devices receiving the command to determine
19 if their chosen random values fall within the specified group and,
20 if so, send a reply to the interrogator within a randomly selected
21 time slot of a number of slots; and, if not, not send a reply; and
22 means for causing the interrogator to determine if a collision
23 occurred between devices that sent a reply and, if so, create a
24 new, smaller, specified group.

1 27. A system in accordance with claim 26 wherein the
2 sending of a reply to the interrogator within a randomly selected
3 time slot is in accordance with an Aloha technique.

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5 28. A system in accordance with claim 26 wherein the
6 sending of a reply to the interrogator within a randomly selected
7 time slot is in accordance with a slotted Aloha technique.

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9 29. A system in accordance with claim 26 wherein the
10 number of slots is four.

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12 30. A system in accordance with claim 26 wherein sending
13 a reply to the interrogator comprises transmitting the unique
14 identification number of the device sending the reply.

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16 31. A system in accordance with claim 26 wherein sending
17 a reply to the interrogator comprises transmitting the random value
18 of the device sending the reply.

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20 32. A system in accordance with claim 26 wherein sending
21 a reply to the interrogator comprises transmitting both the random
22 value of the device sending the reply and the unique identification
23 number of the device sending the reply.
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1 33. A system in accordance with claim 26 wherein the
2 interrogator further includes means for, after receiving a reply
3 without collision from a device, sending a command individually
4 addressed to that device.

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6 34. A system in accordance with claim 26 wherein the time
7 slot randomly selected by a device is selected using a random
8 number different from the random value of that device.

1 35. A system comprising:

2 an interrogator configured to communicate to a selected one
3 or more of a number of communications devices;

4 a plurality of communications devices;

5 the devices being configured to select random values, wherein
6 respective devices choose random values independently of random
7 values selected by the other devices;

8 the interrogator being configured to transmit a command
9 requesting devices having random values within a specified group
10 of random values to respond, the specified group being less than
11 or equal to the entire set of random values;

12 devices receiving the command being configured to
13 respectively determine if their chosen random values fall within the
14 specified group and, if so, send a reply to the interrogator within
15 a randomly selected time slot of a number of slots; and, if not,
16 not send a reply; and

17 the interrogator being configured to determine if a collision
18 occurred between devices that sent a reply and, if so, create a
19 new, smaller, specified group.

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21 36. A system in accordance with claim 35 wherein the
22 predetermined number of bits to be used for the random values
23 comprises sixteen bits.
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1 37. A system comprising:

2 an interrogator configured to communicate to a selected one
3 or more of a number of communications devices;

4 a plurality of communications devices, respective devices being
5 configured to store unique identification numbers respectively having
6 a first predetermined number of bits, respective devices being
7 further configured to store a second predetermined number of bits
8 to be used for random values, respective devices being configured
9 to select random values independently of random values selected by
10 the other devices;

11 the interrogator being configured to transmit a command
12 requesting devices having random values within a specified group
13 of random values to respond, the specified group being less than
14 or equal to the entire set of random values;

15 devices receiving the command respectively being configured
16 to determine if their chosen random values fall within the specified
17 group and, if so, send a reply to the interrogator within a
18 randomly selected time slot of a number of possible time slots, in
19 accordance with an Aloha technique; and, if not, not send a reply,
20 wherein sending a reply to the interrogator comprises transmitting
21 both the random value of the device sending the reply and the
22 unique identification number of the device sending the reply, and
23 wherein the time slot randomly selected by a device is selected
24 using a random number different from the random value of that device;

1 the interrogator being configured to determine if a collision
2 occurred between devices that sent a reply and, if so, create a
3 new, smaller, specified group; and

4 the interrogator being configured to send a command
5 individually addressed to a device after communicating with a
6 device without a collision.

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8 38. A system in accordance with claim 37 wherein the
9 number of possible time slots is four.

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11 39. A system in accordance with claim 37 wherein the
12 number of possible time slots is four, wherein the first
13 predetermined number of bits is sixteen, and wherein the second
14 predetermined number of bits is sixteen.

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16 40. A system in accordance with claim 37 wherein the
17 number of possible slots varies from one specified group to
18 another.